

AMENDMENTS TO THE CLAIMS

This listing of claims supersedes all prior versions and listings of claims in this application:

LISTING OF CLAIMS:

1. (Currently Amended) A phase-locked loop circuit comprising:
 - a DLL circuit having phase difference detecting ~~means~~ unit for detecting a phase difference between a reference clock signal and a synchronous clock signal to be supplied to an electronic circuit which operates in synchronization with said synchronous clock signal,
 - and a phase difference changing ~~means~~ unit for increasing the phase difference between the reference clock signal and the synchronous clock signal as compared to the detected phase difference, if a phase difference between the reference clock signal and the synchronous clock signal is detected by said phase difference detecting ~~means~~ unit,
 - wherein said phase difference changing ~~means~~ unit outputs a reference clock delay signal and a synchronous clock delay signal having a phase difference equal to the sum of the detected phase difference and a predetermined phase difference; and
 - an analog PLL circuit being supplied with said reference clock delay signal and said synchronous clock delay signal from said phase difference changing ~~means~~ unit, controlling the phase of an output control signal to synchronize said synchronous clock delay signal with said reference clock delay signal, and supplying the output control signal as said synchronous clock signal to said electronic circuit.

2. (Currently Amended) A phase-locked loop circuit according to claim 1, wherein said phase difference changing ~~means~~ unit sets the sum of said detected phase difference and said added predetermined phase difference to a value greater than a steady state phase error of said analog PLL circuit.

3. (Original) A phase-locked loop circuit according to claim 1, wherein said DLL circuit comprises:

a phase comparator for detecting the phase difference between said reference clock signal and said synchronous clock signal;

a first delay circuit for delaying said reference clock signal and outputting said reference clock delay signal;

a second delay circuit for delaying said synchronous clock signal and supplying said synchronous clock delay signal; and

a control circuit for being supplied with a signal representing the phase difference detected by said phase comparator, and controlling a delay time of at least one of said first delay circuit and said second delay circuit based on said signal representing the phase difference.

4. (Original) A phase-locked loop circuit according to claim 3, wherein said first delay circuit and said second delay circuit have respective maximum delay times set to a value which substantially corresponds to a steady state phase error of said analog PLL circuit.

5. (Original) A phase-locked loop circuit according to claim 3, wherein said control circuit is supplied with a plurality of detected results from said phase comparator, and if either one of the phases of said reference clock signal and said synchronous clock signal is more delayed than the phase of the other signal less than a predetermined number of times, then said control circuit increases the delay time of the delay circuit for delaying said other signal, and if either one of the phases of said reference clock signal and said synchronous clock signal is more delayed than the phase of the other signal said predetermined number of times or more, then said control circuit does not change the delay times of said first and second delay circuits, but keeps a present delay control action.

6. (Original) A phase-locked loop circuit according to claim 1, further comprising:
a CTS circuit having elements arranged and wired in a tree configuration for equalizing the phase of the output clock signal supplied from said analog PLL circuit and supplying the output clock signal as said synchronous clock signal to an input terminal of said electronic circuit.

7. (Original) A semiconductor integrated circuit incorporating therein said phase-locked loop circuit according to claim 1, said semiconductor integrated circuit being supplied with said reference clock signal from an external source.

8. (Previously Presented) A phase-locked loop circuit comprising:
an analog PLL circuit for comparing the phase of a first signal with the phase of a second signal and outputting a third signal; and
a DLL circuit being supplied with a reference signal and said third signal as a feedback signal, comparing the phase of said reference signal with the phase of said feedback signal, and outputting said first signal and said second signal, wherein
a phase difference between said first signal and said second signal is increased, and
said phase difference is equal to the sum of the phase difference between the reference signal and said third signal and a predetermined phase difference.

9. (Previously Presented) A phase-locked loop circuit according to claim 8, wherein said DLL circuit comprises:

a first delay circuit and a second delay circuit, each comprising a plurality of cascaded unit delay circuits, the arrangement being such that a first unit delay circuit of said first delay circuit receives said reference signal and a predetermined one of the unit delay circuits of said first delay circuit outputs said first signal, and that a first unit delay circuit of said second delay circuit receives said feedback signal and a predetermined one of the unit delay circuits of said second delay circuit outputs said second signal.

10. (Original) A phase-locked loop circuit according to claim 9, wherein said first and second delay circuits have respective total delays each set to a value which substantially corresponds to the absolute value of a steady state phase error of said analog PLL circuit.

11. (Previously Presented) A phase-locked loop circuit according to claim 8, wherein said DLL circuit comprises:

a first delay circuit comprising a plurality of cascaded unit delay circuits, the arrangement being such that a first unit delay circuit of said first delay circuit receives said reference signal, a predetermined one of the unit delay circuits of said first delay circuit outputs said first signal and outputs said feedback signal as said second signal, and said first delay circuit has a total delay set to a value which substantially corresponds to the absolute value of a steady state phase error of said analog PLL circuit.

12. (Currently Amended) A phase-locked loop circuit comprising:

a DLL circuit having phase difference detecting ~~means~~ unit for detecting a phase difference between a reference clock signal and a synchronous clock signal to be supplied to an electronic circuit which operates in synchronization with said synchronous clock signal, and a phase difference changing ~~means~~ unit for, when a phase difference between the reference clock signal and the synchronous clock signal is detected by said phase difference detecting ~~means~~ unit, outputting a reference clock delay signal and a synchronous clock delay signal, with a

predetermined phase difference, being added to increase the detected phase difference between the reference clock signal and the synchronous clock signal;

an analog PLL circuit being supplied with said reference clock delay signal and said synchronous clock delay signal from said phase difference changing ~~means unit~~, controlling the phase of an output control signal to synchronize said synchronous clock delay signal with said reference clock delay signal, and supplying the output control signal as said synchronous clock signal to said electronic circuit; and

wherein said phase difference changing ~~means unit~~ sets the sum of said detected phase difference and said added predetermined phase difference to a value greater than a steady state phase error of said analog PLL circuit.

13. (Currently Amended) A phase-locked loop circuit comprising:

a DLL circuit having phase difference detecting ~~means unit~~ for detecting a phase difference between a reference clock signal and a synchronous clock signal to be supplied to an electronic circuit which operates in synchronization with said synchronous clock signal, and a phase difference changing ~~means unit~~ for, when a phase difference between the reference clock signal and the synchronous clock signal is detected by said phase difference detecting ~~means unit~~, outputting a reference clock delay signal and a synchronous clock delay signal, with a predetermined phase difference, being added to increase the detected phase difference between the reference clock signal and the synchronous clock signal;

an analog PLL circuit being supplied with said reference clock delay signal and said synchronous clock delay signal from said phase difference changing ~~means~~ unit, controlling the phase of an output control signal to synchronize said synchronous clock delay signal with said reference clock delay signal, and supplying the output control signal as said synchronous clock signal to said electronic circuit;

wherein said DLL circuit comprises:

a phase comparator for detecting the phase difference between said reference clock signal and said synchronous clock signal;

a first delay circuit for delaying said reference clock signal and outputting said reference clock delay signal;

a second delay circuit for delaying said synchronous clock signal and supplying said synchronous clock delay signal, wherein said first delay circuit and said second delay circuit have respective maximum delay times set to a value which substantially corresponds to a steady state phase error of said analog PLL circuit; and

a control circuit for being supplied with a signal representing the phase difference detected by said phase comparator, and controlling a delay time of at least one of said first delay circuit and said second delay circuit based on said signal representing the phase difference.

14. (Currently Amended) A phase-locked loop circuit comprising:

a DLL circuit having phase difference detecting ~~means~~ unit for detecting a phase difference between a reference clock signal and a synchronous clock signal to be supplied to an

electronic circuit which operates in synchronization with said synchronous clock signal, and a phase difference changing ~~means~~ unit for, when a phase difference between the reference clock signal and the synchronous clock signal is detected by said phase difference detecting ~~means~~ unit, outputting a reference clock delay signal and a synchronous clock delay signal, with a predetermined phase difference, being added to increase the detected phase difference between the reference clock signal and the synchronous clock signal;

an analog PLL circuit being supplied with said reference clock delay signal and said synchronous clock delay signal from said phase difference changing ~~means~~ unit, controlling the phase of an output control signal to synchronize said synchronous clock delay signal with said reference clock delay signal, and supplying the output control signal as said synchronous clock signal to said electronic circuit;

wherein said DLL circuit comprises:

a phase comparator for detecting the phase difference between said reference clock signal and said synchronous clock signal;

a first delay circuit for delaying said reference clock signal and outputting said reference clock delay signal;

a second delay circuit for delaying said synchronous clock signal and supplying said synchronous clock delay signal; and

a control circuit for being supplied with a signal representing the phase difference detected by said phase comparator, and controlling a delay time of at least one of said first delay circuit and said second delay circuit based on said signal representing the phase difference,

wherein said control circuit is supplied with a plurality of detected results from said phase comparator, and if either one of the phases of said reference clock signal and said synchronous clock signal is more delayed than the phase of the other signal less than a predetermined number of times, then said control circuit increases the delay time of the delay circuit for delaying said other signal, and if either one of the phases of said reference clock signal and said synchronous clock signal is more delayed than the phase of the other signal said predetermined number of times or more, then said control circuit does not change the delay times of said first and second delay circuits, but keeps a present delay control action.

15. (Currently Amended) A phase-locked loop circuit comprising:

a DLL circuit having phase difference detecting ~~means~~ unit for detecting a phase difference between a reference clock signal and a synchronous clock signal to be supplied to an electronic circuit which operates in synchronization with said synchronous clock signal, and a phase difference changing ~~means~~ unit for, when a phase difference between the reference clock signal and the synchronous clock signal is detected by said phase difference detecting ~~means~~ unit, outputting a reference clock delay signal and a synchronous clock delay signal, with a pre-determined phase difference, being added to increase the detected phase difference between the reference clock signal and the synchronous clock signal;

an analog PLL circuit being supplied with said reference clock delay signal and said synchronous clock delay signal from said phase difference changing ~~means~~ unit, controlling the phase of an output control signal to synchronize said synchronous clock delay signal with said

reference clock delay signal, and supplying the output control signal as said synchronous clock signal to said electronic circuit; and

further comprising:

a CTS circuit having elements arranged and wired in a tree configuration for equalizing the phase of the output clock signal supplied from said analog PLL circuit and supplying the output clock signal as said synchronous clock signal to an input terminal of said electronic circuit.

16. (Previously Presented) A phase-locked loop circuit comprising:

an analog PLL circuit for comparing the phase of a first signal with the phase of a second signal and outputting a third signal; and

a DLL circuit being supplied with a reference signal and said third signal as a feedback signal, comparing the phase of said reference signal with the phase of said feedback signal, and outputting said first signal and said second signal based on a result of comparison between the phase of said reference signal and the phase of said feedback signal,

wherein said DLL circuit comprises:

a first delay circuit and a second delay circuit, each comprising a plurality of cascaded unit delay circuits, the arrangement being such that a first unit delay circuit of said first delay circuit receives said reference signal and a predetermined one of the unit delay circuits of said first delay circuit outputs said first signal, and that a first unit delay circuit of said second delay circuit receives said feedback signal and a predetermined one of the unit delay circuits of said second delay circuit outputs said second signal.

17. (Previously Presented) A phase-locked loop circuit comprising:

an analog PLL circuit for comparing the phase of a first signal with the phase of a second signal and outputting a third signal;

a DLL circuit being supplied with a reference signal and said third signal as a feedback signal, comparing the phase of said reference signal with the phase of said feedback signal, and outputting said first signal and said second signal based on a result of comparison between the phase of said reference signal and the phase of said feedback signal;

wherein said DLL circuit comprises:

a first delay circuit and a second delay circuit, each comprising a plurality of cascaded unit delay circuits, the arrangement being such that a first unit delay circuit of said first delay circuit receives said reference signal and a predetermined one of the unit delay circuits of said first delay circuit outputs said first signal, and that a first unit delay circuit of said second delay circuit receives said feedback signal and a predetermined one of the unit delay circuits of said second delay circuit outputs said second signal; and

wherein said first and second delay circuits have respective total delays each set to a value which substantially corresponds to the absolute value of a steady state phase error of said analog PLL circuit.

18. (Previously Presented) A phase-locked loop circuit comprising:

an analog PLL circuit for comparing the phase of a first signal with the phase of a second signal and outputting a third signal; and

a DLL circuit being supplied with a reference signal and said third signal as a feedback signal, comparing the phase of said reference signal with the phase of said feedback signal, and outputting said first signal and said second signal based on a result of comparison between the phase of said reference signal and the phase of said feedback signal,

wherein said DLL circuit comprises:

a first delay circuit comprising a plurality of cascaded unit delay circuits, the arrangement being such that a first unit delay circuit of said first delay circuit receives said reference signal, a predetermined one of the unit delay circuits of said first delay circuit outputs said first signal and outputs said feedback signal as said second signal, and said first delay circuit has a total delay set to a value which substantially corresponds to the absolute value of a steady state phase error of said analog PLL circuit.

Please add the following new claim 19:

19. (New) A phase-locked loop circuit according to claim 1, wherein said predetermined phase difference is substantially equal to a steady state phase error of said analog PLL circuit.